

## **Historic, archived document**

Do not assume content reflects current scientific knowledge, policies, or practices.

Issued May 22, 1907.

U. S. DEPARTMENT OF AGRICULTURE.

---

FARMERS' BULLETIN 291.

---

# EVAPORATION OF APPLES.

BY

H. P. GOULD,

*Assistant Pomologist, Bureau of Plant Industry.*



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1907.

## LETTER OF TRANSMITTAL.

---

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
OFFICE OF THE CHIEF,  
*Washington, D. C., March 28, 1907.*

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin, the accompanying manuscript, entitled "Evaporation of Apples," by H. P. Gould, Assistant Pomologist.

While the recent tendency in the apple industry has apparently been to centralize fruit evaporation into distinct commercial establishments having considerable capacity and requiring capital to construct and equip, there still remain large regions in which there is a considerable surplus of fruit that is unsuitable for packing and shipping in almost every crop year. In these sections and in the less accessible commercial fruit regions there is need of stimulation of effort to utilize the lower and less desirable grades of apples in such ways as will at the same time yield a fair return to the producer and remove them from competition with the better grades in the market. Encouragement of evaporating, canning, cider making, and other methods of utilization therefore appears desirable, and of these evaporating is the one that is most applicable at present to a wide range of conditions, and therefore of most importance to the average farmer.

Respectfully,

B. T. GALLOWAY,  
*Chief of Bureau.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

# CONTENTS.

	Page.
Introduction .....	5
Types of evaporators.....	6
Cook-stove evaporators .....	7
Portable outdoor evaporators.....	7
Kiln evaporators .....	8
Tower evaporators .....	15
Miscellaneous types of evaporators.....	17
Evaporator appliances, etc.....	18
Paring tables .....	18
Paring machines .....	18
Bleachers .....	19
Sulphur stoves .....	22
Slicing machines .....	22
Crates and trays.....	22
Racks .....	22
Heating apparatus .....	23
Fuel .....	25
Quantity of fuel required.....	25
Apples suitable for evaporation.....	26
Preparing the fruit for drying.....	27
Paring .....	27
Trimming .....	27
Bleaching .....	27
Slicing, quartering, etc.....	28
Drying the fruit.....	29
Capacity of floor space and racks.....	29
Oiling the floors and racks.....	29
Temperature maintained .....	30
Turning the fruit.....	30
Time required for drying.....	31
When is the fruit dry?.....	31
The curing room.....	32
Handling the waste.....	32
Weight of evaporated apples.....	33
Laws relating to evaporated fruits.....	33
Handling evaporated apples.....	34
Range of prices.....	34
Grading .....	35
Kinds of packages used.....	35
Packing .....	36
Storing the fruit.....	38

## ILLUSTRATIONS.

---

	Page.
FIG. 1. A small portable evaporator constructed of wood.....	7
2. Exterior of a conveniently arranged two-kiln evaporator.....	8
3. First-floor plan of the evaporator illustrated in figure 2, showing the position of the principal articles of equipment.....	9
4. Second-floor plan of the evaporator illustrated in figure 2, showing the position of the principal articles of equipment.....	10
5. Interior view of the evaporator illustrated in figure 2, showing the paring room and the position of the table, parers, and other conveniences .....	11
6. Paring shed and bleachers of a large kiln evaporator built of brick .....	12
7. A one-kiln evaporator, with bins for apples adjoining the paring room .....	13
8. First-floor plan of the evaporator illustrated in figure 7, showing the arrangement of the principal details.....	14
9. Section of a kiln floor, showing the method of construction.....	15
10. A horizontal power bleacher.....	21
11. A "board" of facers.....	36
12. A press used in packing evaporated apples.....	36
13. A 50-pound box of "fancy" evaporated apples with cover re- moved .....	37
14. A 50-pound box of "fancy" evaporated apples with cover and paper face removed.....	37
15. A 50-pound box of "prime" whole apples.....	38
16. A 50-pound box of "prime" quarters.....	38

## EVAPORATION OF APPLES.

---

### INTRODUCTION.

The utilization of the poorer grades of fruit is frequently an important matter to the grower. That portion of a crop which is of too low grade to market in the ordinary way can often be made to pay a large part, at least, of the expense of maintaining the orchard or fruit plantation if it is converted into some other form or handled in some way other than that practiced with the better grades. In some of the apple-growing districts the evaporating industry has kept pace with the planting of orchards and has become an important factor in the utilization of the fruit which is unfit or would prove unprofitable for marketing in the fresh state. In some of the older apple-growing sections, such as western New York, the number of evaporators in use is very large, and for many years the industry has been well established. Its present state of development, however, has been a matter of gradual evolution. During its course methods have changed more or less, appliances have been perfected, and marked improvement in the construction of the evaporators themselves has been accomplished.

The data presented in the following pages have been secured in visiting a large number of evaporators where the methods, appliances, conveniences, etc., have been studied and the operators interviewed. The information relating to packing and handling the product has come largely through the courtesy of dealers in evaporated apples. Acknowledgment is gladly made of this assistance.

Many evaporators are located in villages, at railroad stations, and at other central points; a considerable number, however, are erected in close proximity to or in conjunction with apple orchards, being owned and operated by the fruit growers themselves, each plant being intended only for "working up" the fruit not otherwise marketed from a single orchard. The evaporators located in towns or villages are usually operated by men who make a business of evaporating fruit, and the apples handled in them are bought wherever they can be obtained to best advantage. These are generally of much larger capacity than the ones at the orchards, and the type of construction and the character and number of conveniences correspond.

The average weight of ripe winter apples of mixed varieties is about 50 pounds to the bushel. In evaporating them about 40 pounds of water per bushel, or approximately 5 gallons, passes off in the form of vapor. The evaporating of apples may be said, in brief, to consist of driving off as rapidly as possible, by means of artificial heat, enough of their moisture to prevent deterioration through decay or other natural processes which occur in fresh fruit and at the same time to maintain a desirable texture and flavor.

Buildings formerly used for other purposes are frequently converted into evaporators. An old dwelling house, a blacksmith shop, a cheese factory, and even a schoolhouse and a church are examples. Others are built substantially of brick or stone, thus reducing the risk from fire, which is an important consideration.

A large quantity of fruit, in the aggregate, is still dried by primitive methods. In rural communities, especially where the "home orchard" represents the extent of fruit growing, one often sees during the autumn a flat-topped rock, the roof of some low, easily accessible shed, or other flat surface on which have been spread apples, sliced or quartered, for drying in the sun. In some sections "strings" of quartered apples hanging by a doorway to dry, or behind a kitchen stove, are still familiar sights.

While much of this sun-dried fruit is intended for home use, large quantities of it are marketed, and it is also exported to some extent. This fruit is commonly referred to as "dried apples," in distinction from that handled in evaporators, which is known as "evaporated apples."

### TYPES OF EVAPORATORS.<sup>a</sup>

Many types of evaporators are now in use, though in a general classification they may be grouped, for convenience, under a few heads. The more important of these are:

1. Cook-stove evaporators.
2. Portable outdoor evaporators.
3. Kiln evaporators.
4. Tower evaporators.
5. Miscellaneous types.

It is well to emphasize, at this point, the **fact** that the descriptions which follow are representative of types only and that the details

---

<sup>a</sup> The first three types of evaporators to be described are better suited to the needs of the average fruit grower than are the last two mentioned. The latter are more complicated in construction and would ordinarily be used only in cases where the extent of the business and the investment involved require more detailed information than it is possible to give in the scope of this bulletin. Certain other types of evaporators and another phase of the evaporating industry are considered in Farmers' Bulletin No. 213.

of construction and arrangement admit of endless modification. For the most satisfactory results, however, in all types, thorough ventilation is essential to insure a good circulation of heated currents of air.

#### COOK-STOVE EVAPORATORS.

Some of the cook-stove evaporators are small box-like structures, usually made of sheet iron or galvanized iron, of such a size that they can be placed on top of an ordinary cook stove. They are arranged for holding a series of small trays, on which the fruit is placed after it has been prepared for drying. Various sizes are in use, from one covering only a portion of the top of a common kitchen stove and having a capacity of only a bushel or so a day, to those requiring the entire top of a stove on which to operate it.

Another style consists of a water-tight rectangular box of tin, upon the upper surface of which the fruit is spread. The heat is supplied by boiling water, with which the evaporator is filled, the temperature being maintained by placing one end of the evaporator on top of a stove. There are various other styles of this type.

#### PORTABLE OUT-DOOR EVAPORATORS.

Portable evaporators are especially convenient when it is desired to dry only a few bushels of fruit at any one time. The usual sizes have a capacity of 5 to 10 bushels a day, and even more in some cases,

although the quantity will of course vary with the attention given to them. As they are complete in themselves and are not too heavy to be readily moved, they may be placed wherever convenience from time to time dictates.

Figure 1 shows an evaporator of this type which is constructed entirely of wood, except the parts in direct contact with the heater.

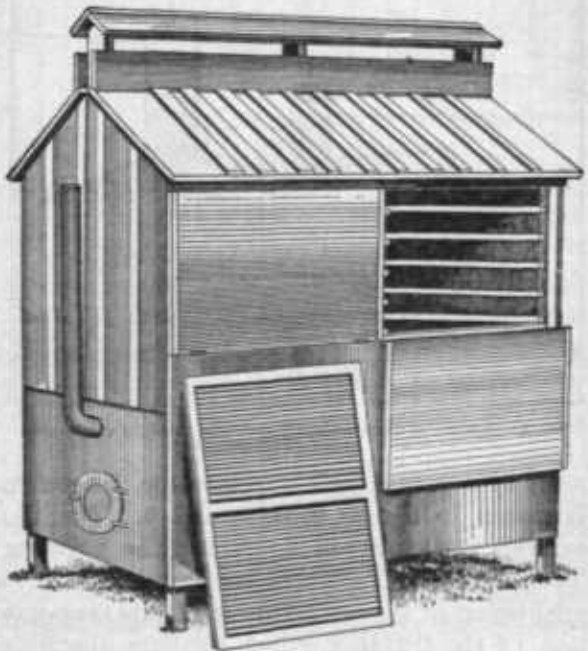


FIG. 1.—A small portable evaporator constructed of wood.

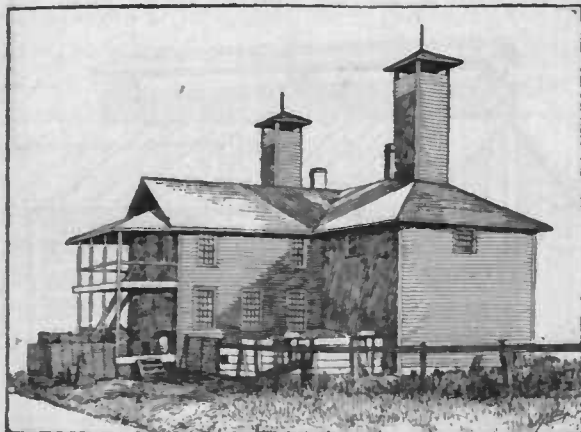


There is space for ten trays for holding fruit, similar to the one in the illustration, the dimensions of which are  $2\frac{1}{2}$  by 3 feet. Each tray holds about one-half bushel of fruit. Modifications of such an equipment to suit individual needs and conveniences readily suggest themselves.

There are several other styles of this type obtainable from manufacturers which are made of sheet iron, usually galvanized. As no wood enters into their construction, danger from fire is eliminated. One of these styles is provided with a heat deflector and so constructed that hot currents of air pass over the fruit as well as up through it, the claim being made that this movement of air induces a more rapid drying of the fruit than in ordinary methods of construction.

### KILN EVAPORATORS.

Of the types having sufficient capacity for handling apples from



large commercial orchards, the kiln evaporator is by far the most important.

While the principles of construction of the different evaporators of this type are similar in all cases, the details and the arrangement of the appliances are endlessly varied.

The arrangement of a very complete evaporator, from a mechanical standpoint, is shown in figures 2, 3, 4, and 5. The general features of the exterior are shown in figure 2. The building is two stories high. The floor plans suggested by figures 3 and 4 are in a measure an adaptation of the arrangement of this evaporator. The central portion of the building, which contains the floors where the fruit is prepared for drying, is 20 by 40 feet. The wings on either side, which contain the kilns where the fruit is dried, are each 20 feet square. At the front of the building shown in figure 2 can be seen an elevator by which the apples are carried to the second floor and dumped into a large bin (fig. 4, *K*). This elevator is an endless sprocket chain provided with lugs similar to the one which can be seen at the right in figure 5. The bin (fig. 4, *K*) is directly over the

the paring table (*C*) in figure 3. From this bin the apples drop down the conveyors (to be seen in fig. 5) to the paring table on the first floor. As will be observed, one of these conveyors is provided for each paring machine. At the base of each there is attached a small box into which the fruit settles, where it can be readily reached by those who operate the parers.

As the apples are pared, the peelings drop into a carrier which runs under the table, passing directly beneath the machines, and which takes them to the elevator shown in figure 5 at the right, and by this they are raised to the second floor, where they are put by

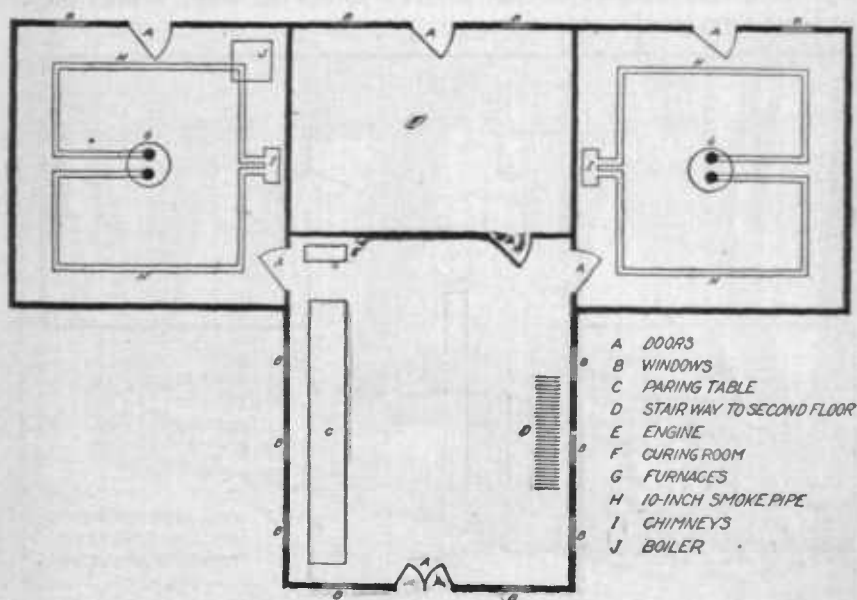


FIG. 3.—First-floor plan of the evaporator illustrated in figure 2, showing the position of the principal articles of equipment.

hand into the bin shown in figure 4, *N*. Here they remain until they are placed on the kiln floor to dry.

The pared apples drop to the paring table when they are forced off the machines. They are then trimmed (an operation to be described later), dropped into a carrier which runs in the opposite direction from the one which receives the peelings, taken to the elevator at the remote end of the paring table, by which they are raised to the bleacher (figure 4, *L*) on the second floor. They are delivered from the bleacher to the slicer, shown in figure 4, *M*, and are then spread on the kiln floors (*O*, *O*). It will thus be seen that with this arrangement the fruit passes from one operation to another with a minimum of hand labor.

Other points in the arrangement of the appliances indicated in figures 3 and 4 require notice. In the former, which shows the first floor, *D* is the stairway leading to the second floor; *E* is an engine which supplies the necessary power for running the parers, elevators, and other machinery; *F* is the room which receives the evaporated fruit when it is taken from the kilns; *G, G* are the furnaces which supply the heat for drying the fruit; *H, H* are 10-inch pipes leading from the furnaces to the chimneys at *I, I*; *J* is the boiler supplying steam for the engine (*E*).

In the diagram of the second floor (figure 4) the only points which require further notice are small doors *P, P* in the walls, which com-

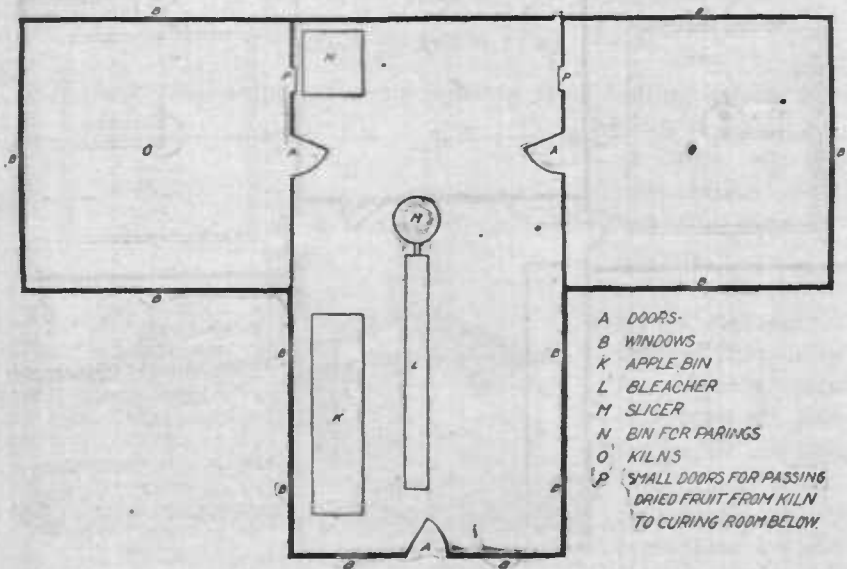


FIG. 4.—Second-floor plan of the evaporator illustrated in figure 2, showing the position of the principal articles of equipment.

municate with the curing room (*F*) on the first floor, and through which the fruit is passed when removed from the kilns.

This evaporator is located in Wayne County, N. Y. It was built about 1903. It is a frame building very thoroughly constructed and completely equipped. The approximate cost of the plant, the capacity of which is about 300 bushels for ten hours, with the kilns drying continuously, as stated by one of the owners, was as follows:

Building .....	\$1,800.00	1 chopper .....	\$8.00
2 furnaces .....	150.00	Engine, boiler, shafting, pul-	
5 parers .....	60.00	leys, belting, etc. ....	450.00
1 20-foot horizontal bleach		Installing machinery .....	100.00
er .....	75.00		
1 slicer .....	37.50	Total .....	2,680.50

A convenient arrangement for an evaporator having four or five kilns is shown in figure 6. In this one the kilns are built of brick, and the apples are pared in an adjacent building. Referring to the illustration, the portion built of slats at the left is the compartment for containing the apples in bulk. This bin extends the entire length of the building, except a small space in the center where a 5-horsepower gasoline engine is located which furnishes power for running the parers, slicers, and other machinery. The paring table<sup>a</sup> is on the opposite side of the building, as will be noted, from which the fruit is taken by a carrier, similar to those already described, and elevated to a platform which is on the same level as the two bleachers,

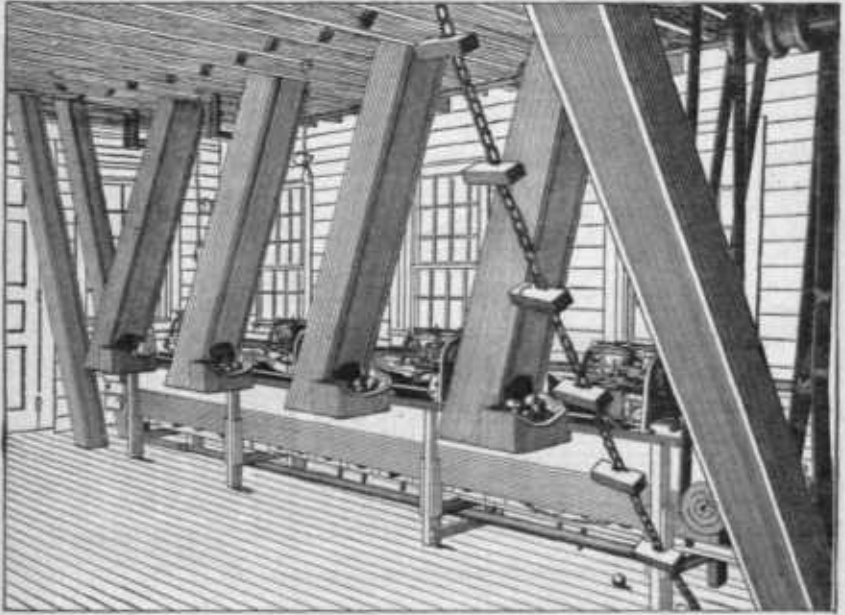


FIG. 5.—Interior view of the evaporator illustrated in figure 2, showing the paring room and the position of the table, parers, and other conveniences.

which are to be seen between the evaporator and the paring shed just mentioned. This carrier discharges the fruit into trays, which are then placed by hand in one of the bleachers; from this they are taken to the slicer, located in a compartment just within the brick portion of the structure and with which all the kilns communicate, thus making it convenient to distribute the fruit after it has been sliced.

Other large establishments have the kilns arranged in a series situated end to end. The fruit is pared on the first floor of an

<sup>a</sup> At the time the photograph from which this illustration was made was taken this evaporator was not in operation. The parers were covered with boxes, which are seen where the machines would otherwise appear.

adjoining structure centrally located; then elevated to the second floor, which is on the same level as the kiln floors, where it is bleached and sliced. Communication is had with the kilns not adjacent to the floor on which the fruit is sliced, by means of a platform extending from this floor along the sides of the kilns and on the same level as the kiln floors.

Of the smaller evaporators, operated entirely by hand, of which there are relatively a great number, a similar arrangement on a correspondingly limited scale will be found convenient. Where buildings which were erected for other purposes are remodeled for this use it may often be necessary to forego some of the conveniences

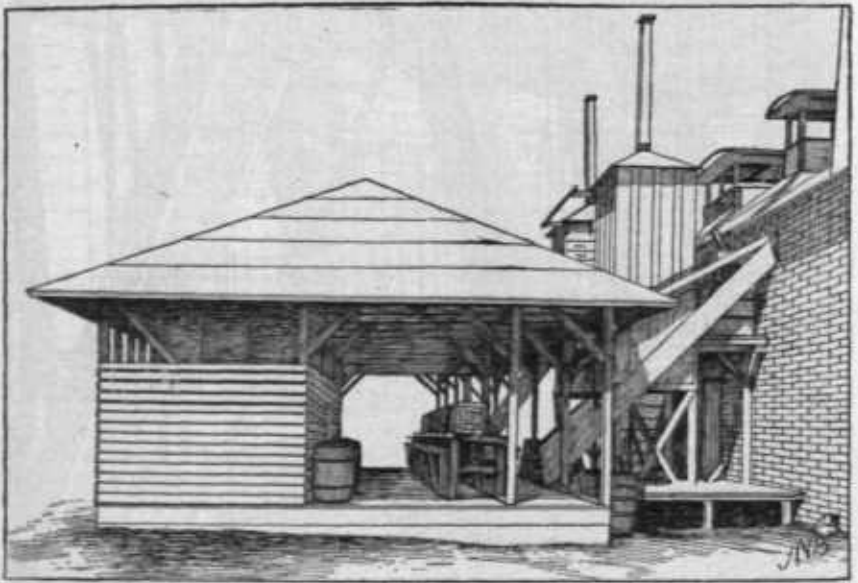


FIG. 6.—Paring shed and bleachers of a large kiln evaporator built of brick.

which could be included in a building erected primarily for the evaporation of fruit.

A conveniently arranged one-kiln evaporator is shown in figure 7. The plan of the first floor is suggested by figure 8. The space is divided into a furnace room about 14 by 16 feet and a workroom, which is somewhat smaller, in which the apples are pared. An upright bleacher, which also serves as an elevator for raising the fruit to the second floor, is placed in this room. The second floor is divided in a similar way. The kiln has the same dimensions as the furnace room, with a capacity of 75 to 100 bushels of fruit (before paring) at each filling. The workroom on this floor contains the slicer and the upper portion of the bleacher. The dried

fruit, as it is taken from the kiln, can also be held here temporarily if desired.

The evaporator shown in figures 7 and 8 is constructed entirely of wood and was built in 1896 at a cost of about \$300, including material and labor. It is located in western New York. At the present prices of lumber the cost would be considerably greater. A builder who could secure the lumber from his own timber tract would be able to greatly reduce the actual cash outlay. According to a statement of the owner the cost of equipment was as follows:

1 furnace .....	\$47
2 parers .....	16
1 slicer .....	15
1 chopper .....	8
Ropes and pulleys for bleacher and elevator .....	3
<b>Total cost of equipment.....</b>	<b>89</b>

Such a building as the one described may readily be so constructed that it will be useful for many other purposes during the course of a year than that for which it is primarily intended.

In constructing kilns the same general principles are followed, whether the evaporator is a small one with only a single kiln or an extensive establishment having several of them. The most satisfactory size of kiln, all things considered,

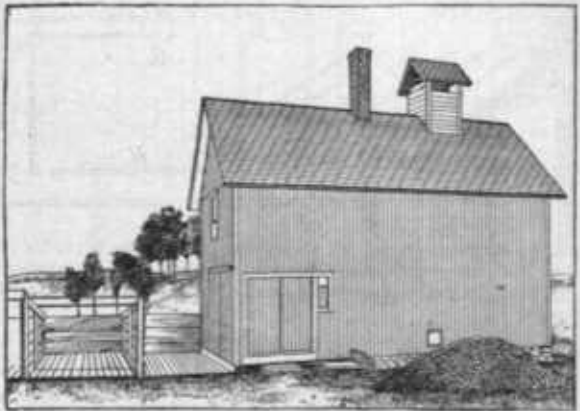


FIG. 7.—A one-kiln evaporator, with bins for apples adjoining the paring room.

is about 20 feet square. This is a convenient size to fill, so far as the preparation of the fruit is concerned; the heat can be well regulated, made sufficiently intense for the purpose desired, and evenly distributed, so that the fruit will dry uniformly, and for various minor reasons a kiln of this size is a desirable "unit" in the construction of evaporators of this type.

A kiln consists essentially of a floor made of slats and placed over a furnace room or over a system of steam pipes. The floor is usually built from 10 to 12 feet above the floor of the furnace room. Provision should be made for regulating the heat by means of small

openings at the base of the walls, communicating with the outside, which can be opened or closed as desired. The inflow of cold air can thus be regulated. Such control is especially desirable in windy weather. While many evaporators are constructed without special provision of this kind, it is an important point to have such openings, particularly if the walls are brick or otherwise made very tight, so that there is but little circulation of air.

If the evaporator is a frame building, the walls of the furnace room may well be plastered or covered with asbestos paper to lessen the danger of fire, which may otherwise be great, because of the intense heat generated within them.

If the walls, at least the portion below the kiln floor, are double,

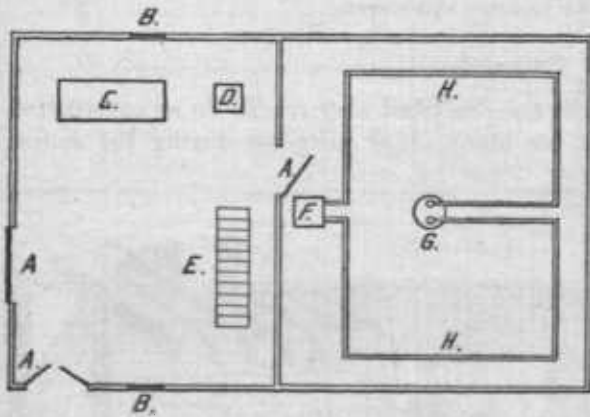


FIG. 8.—First-floor plan of the evaporator illustrated in figure 7, showing the arrangement of the principal details: A, doors; B, windows; C, paring table; D, bleacher; E, stairs; F, chimney; G, furnace; H, pipes.

with an air space between the two sides, the insulation will be more perfect than if they are solid or of only a single thickness, thus best conserving the heat and increasing the efficiency of the plant. The height of the walls of the kiln above the drying floor should be sufficient to permit an attendant to work on the floor conveniently and with comfort.

Some means for the escape of the air laden with moisture from the fruit is necessary. This may be provided for by means of an opening in the roof similar to that shown in figure 1, page 7; or a cupola-like ventilator may be built, the sides of which should consist of slats placed so that they overlap one another as in an ordinary window blind. Another form of ventilator is shown in figure 2, page 8. This is in the form of a tower about 3 feet square and extending 8 or 10 feet above the roof, which is sufficiently high to cause more or less draft, and hence augments the circulation of hot air through the fruit.

The kiln floor is constructed of strips especially designed for the purpose. Such floors are generally made of poplar or basswood strips, seven-eighths of an inch thick, 1 inch wide on the top surface and one-half inch wide on the under side. In laying the floor, these strips are placed one-eighth to one-fourth inch apart on the upper



surface. This makes the space between them wider on the under side than on the upper, thus allowing the small particles of fruit which work down between them to drop through without clogging the intervening spaces. Reference to figure 9 will make plain the method of constructing the floor.

The heating apparatus, parers, slicers, bleachers, details of arrangement, etc., referred to here are described under their respective headings.

### TOWER EVAPORATORS.

At one time tower evaporators were extensively used in some sections for apples, but in recent years this type has been largely superseded by the kiln evaporator, so that at the present time there are comparatively few towers in use.

As the name of this type implies, a tower is its characteristic feature of construction. It may be likened to an immense chimney, provided with the necessary appliances for receiving the fruit, except that the heat alone is allowed to pass through it, a separate flue being provided for the smoke.

There is no more definitely prescribed manner in which these towers are constructed and arranged than there is governing the construction of kiln evaporators. They may consist of one tower or several. If several, they may be entirely disconnected from one another. They may be built side by side or back to back, opening on the opposite sides. They may be entirely within the building, extending through the several floors from basement to roof and projecting above, or entirely on the exterior, opening into the interior after the manner of an "outside chimney," common in some sections of the country. They may be built either of wood or brick. They are usually from 4 to 5 feet square, inside measure, and 30 or 35 feet in height, as desired. Heat is supplied by a furnace at the bottom of the tower.

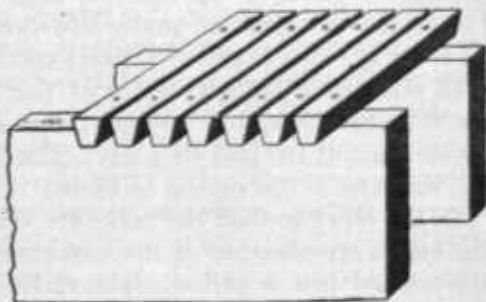


FIG. 9.—Section of a kiln floor, showing the method of construction.

There are two principal methods of constructing the towers in regard to receiving and handling the fruit to be dried. The apparatus in one case consists of two endless sprocket chains operating over wheels properly adjusted at the top and bottom of the tower. Each sprocket chain is provided with swinging brackets, corresponding



with one another on each chain, for holding the racks on which the fruit is placed for drying. In one specific make of apparatus these brackets are arranged in series of six each, so that this number of racks can be put in, one immediately above another. A space of 2 feet or so intervenes on the sprocket chains between each series of six brackets. This sprocket-wheel-and-chain device for carrying the fruit in the tower is turned by means of a crank, which works on the outside of the tower.

The racks on which the fruit is dried consist of frames 4 feet long and  $21\frac{1}{2}$  inches wide, over which is placed galvanized-wire netting having a quarter-inch mesh. This size of rack permits the apparatus on which the racks are carried in the tower to work readily, those on one side passing upward, while those on the other side move downward, without interfering with one another.

In this method the point of admitting the fruit to the tower is near the base on the first floor. When the fruit is dry it is removed at the same point.

In operating the tower, the apparatus is turned every few minutes to bring each rack of fruit in its course to the base of the tower, where the heat is greatest. In this way it is made to dry uniformly, and each rack is brought repeatedly into view of the one in charge; hence he is always able to know its exact condition.

In one particular evaporator of this kind there are three towers, about 30 feet high, each holding 120 racks. The capacity of a single tower is about 100 bushels a day. The fruit is prepared in every detail the same as for drying in kilns.

In the other method the racks are about 4 feet square and occupy the entire cross section of the tower instead of half the space, as in the method just described. The racks are admitted to the tower at the same point as in the other style, but as each rack is put in position it is raised by a lever attachment, together with the other racks which may have been already put in place, and held in the new position by dogs or clutches which work automatically, allowing the racks to be moved upward, but not permitting them to move downward. The distance which the racks are raised each time the lever is moved is sufficient to allow another rack to be inserted below them at the usual point of admission. It will thus be seen that the racks are gradually raised from the point of insertion on the first floor to the point on the second floor where they are removed. The racks do not come into the view of the operator from the time they are inserted until they reach the place where they are removed, and so do not come under the same scrutiny of the operator as in the other style. The arrangement of the furnaces is the same in both methods of construction.

## MISCELLANEOUS TYPES OF EVAPORATORS.

While the types of evaporators previously described admit of endless modification in the details of construction, and other types and styles of lesser importance are frequently seen, there is but one additional evaporator to which it seems desirable to refer in this connection. The type in question has no particular designating term applied to it. Several styles which possess some features similar to this one have been called "cabinet evaporators,"<sup>a</sup> and this term is applicable in the present instance. While it appears to be largely of local reputation, it is believed to possess certain points of merit worthy of more extended application in constructing evaporators of considerable capacity. The fruit is dried on racks similar to those used in tower evaporators.

In the first one of this type to be erected, so far as the writer has been able to learn, and which is still in use, the compartments in which the fruit is dried are located in the central part of a large room in which the fruit is sliced and handled after it is removed from the evaporator. Each compartment, of which there are three, is slightly more than 8 feet square, or large enough in cross section to receive four racks (two square) on the same plane. The two opposite faces or sides of these compartments are a series of narrow doors, about 6 inches wide and slightly more than 4 feet long, which extend horizontally. These doors are hinged on the lower side and held in place by a button at the top. The sides of the interior are supplied with cleats on which the racks rest. Two racks placed one directly on the other are admitted at each door. In the particular case in question, there is sufficient space between the floor and ceiling of the room for eleven of these doors, each door admitting, as stated, two racks. It will thus be seen that the capacity of each compartment is 88 racks.

As arranged in this evaporator, the racks are admitted to the drying compartments on the same side of the room that the apples are sliced, the ones that are put in first being pushed to the opposite side of the compartment, thus making room for the second set of racks in the course. The attendant in charge of the drying makes his examinations and removes the fruit when dry through the doors on the opposite side of the compartment.

It will thus be seen that the method of handling the fruit is similar to that employed in the case of the tower driers, but the work is all done on a single floor of the evaporator.

The heat is supplied by a system of steam pipes which extend in horizontal tiers through the compartments between the racks.

---

<sup>a</sup> See Farmers' Bulletin No. 213, "Raspberries," p. 25.

## EVAPORATOR APPLIANCES, ETC.

During the development of the industry, the machinery and other appliances used in the process of evaporating apples have undergone great changes, until at the present time a high degree of perfection has been attained. Reference to some of the more important articles for equipping an evaporator may be of value to those who are unfamiliar with them. Nearly all of them may be obtained from manufacturers ready for use, hence detailed descriptions are unnecessary in most cases.

### PARING TABLES.

Paring tables hardly require special reference in the present connection, but brief descriptions of a number that are conveniently arranged may be suggestive. There are two general plans of construction. One consists of a single long table common to all the machines; the other, individual tables, one for each parer.

Where several hand parers are used they are commonly placed on opposite sides of a relatively wide table, through the center of which, between the two rows of parers, is a sluice 10 or 12 inches wide and as many inches deep. An endless belt the width of the sluice covers its bottom. This belt works on rollers and is operated by means of a crank at the outer end. As the apples are trimmed they are thrown into this sluice, and the helper who attends to the bleacher fills the crates or trays in which the fruit is handled by turning the crank which moves the belt forward, carrying with it the fruit which has been placed thereon. By this means all the trimmers contribute to the filling of a single tray, thus making it possible to get all the fruit into the bleacher in the shortest possible time after it is pared. This is considered essential in order to make the highest grade product. Such a table as this is especially adapted to small evaporators which are run entirely by hand power.

In power evaporators a long table common to all the parers similar to the one in figure 5, page 11, is generally used. The necessary carriers for removing the apples and the parings operate beneath the table. If individual tables are used in such cases, a small sluice may connect each table with a carrier which works just beneath the floor, which carrier in turn delivers to an elevator that connects with the bleacher. By thus placing below the floor the carrier which takes the fruit from the tables, the space above is left unobstructed, which would not be the case were the individual tables connected with a common carrier.

### PARING MACHINES.

Paring machines are made for operating either by hand or power. The more recent patterns have two, or even three, forks for holding

the apples while they are being pared. The attendant puts an apple on one of the forks while one on another fork is being peeled.

The number of bushels which can be pared in a given time of course varies with the size and condition of the fruit, but 70 or 75 bushels for a day of ten hours (or even more if the fruit is of good size and the machine is speeded up to its limit) is not an unusual amount for a good power machine.

The hand machines are equally complete and satisfactory in their working. Under favorable conditions an experienced operator will pare 60 or more bushels a day if the fruit is not too small.

#### BLEACHERS.

In order to make the fruit as white as possible, it is usually subjected to the fumes of burning sulphur. The apparatus in which the fumes are applied is called a bleacher.

The form and manner of construction vary greatly, as do most of the other appliances. The requisites are a perfectly tight compartment having a capacity commensurate with the size of the evaporator and the necessary facilities for burning the sulphur.

Perhaps the simplest form of construction consists of a box sufficiently long to meet the requirements, placed horizontally, and large enough in cross section to admit the boxes or crates in which the fruit is handled. Rollers are placed in the bottom, on which the crates rest, which permit them to be moved along with but little friction. The crates are entered at one end of the bleacher, those previously put in being pushed along to make room for the following ones. The sulphur is usually burned immediately below the point where the fruit is put into the bleacher. A short piece of stovepipe is placed at the opposite end for the escape of the fumes after they have passed through the bleacher.

Another simple bleacher in which the fruit is handled in bulk (not in crates) consists essentially of a large square box, the interior of which is fitted with a series of inclined planes sloping in opposite directions to prevent the fruit from dropping to the bottom in a compact mass. The fruit is usually admitted at the top directly from the paring table. It then rolls from one inclined plane to another to the bottom, where there is the necessary opening, with means for closing it tightly to prevent the escape of the sulphur fumes, for removing the fruit when it is bleached. The sulphur is burned beneath the lowest inclined plane.

The bleachers shown in figure 6, page 12, are compartments 4 or 5 feet square and 5 or 6 feet high. The two bleachers, which can be seen in the illustration, face toward the platform, which extends between them. The sides of the interior are provided with series of

cleats for supporting the trays in which the fruit is handled. The distance between the cleats is slightly more than the depth of the trays. The sides toward the platform consist of series of closely fitting doors about 6 inches wide, placed horizontally, through which the trays are entered and removed from the bleachers. The trays of fruit are put into the bleachers and left in the sulphur fumes a sufficiently long time for the fruit to bleach. The sulphur is burned at the bottom of the bleachers, and the tall shafts which are to be seen projecting from the top are ventilators, which give sufficient draft to take the fumes up through the fruit and to allow their escape at a point some distance above the workmen.

While all of these types may do the work well, they are so constructed that much handling and lifting of the fruit is necessary.

There is an upright style in common use in some sections, which reduces the lifting of the fruit by hand to a minimum and serves not only as a bleacher, but also as an elevator. This is especially suited to the smaller, two-story evaporators, operated without mechanical power, in which the slicing is done on the second floor and having the kiln floor on the same level. By this means the fruit is raised from the first or paring-room floor to the level of the kiln floor while it is being bleached.

The construction is comparatively simple. It consists of an upright box extending from the first floor to 3 or 4 feet or any convenient height above the second. The cross dimensions are such as to admit the crates or trays in which the fruit is handled. The crates are admitted to the bleacher at a convenient height, 18 inches or 2 feet from the bottom, through a trapdoor or some other arrangement which can be tightly closed to prevent the escape of the sulphur fumes.

A movable frame, slightly smaller than the cross dimensions of the bleacher, rests on a solid support just below the point where the crates are entered and on which the crates are placed when pushed inside. This frame is connected with a lever at the top of the bleacher by means of iron rods which are attached to a cross arm on the lever and extend down the sides of the bleacher to the frame. The relative length of the long and short arms of the lever must be such that in the sweep of the long arm the frame on which the crates rest will be raised a distance slightly greater than the depth of the crates in which the fruit is handled. There are dogs, or catches, on the inside of the bleacher, which work automatically and permit the crates to be moved upward, but not downward. When a crate is put in place, the lever is pulled down, usually by means of a rope which passes through the second floor within convenient reach of the helper

who handles the crates. The crate which was last put into the bleacher and all that may have been put in previously are raised to the point where they are caught by the clutches just mentioned and so held in that position. On releasing the lever, it regains its former position and the frame drops to its place just below the level of the doorway through which the crates are admitted and is then ready for receiving another crate. A small-sized stovepipe or other tubing should extend from the top of the bleacher to the exterior of the building to permit the escape of the sulphur fumes after they have passed through the fruit.

The crates are removed through a tightly closing door in the bleacher on the second floor, where the apples are sliced and spread on the kiln floor.

The sulphur is burned at the bottom of the bleacher, below the point where the fruit is admitted. It is a safe provision to have

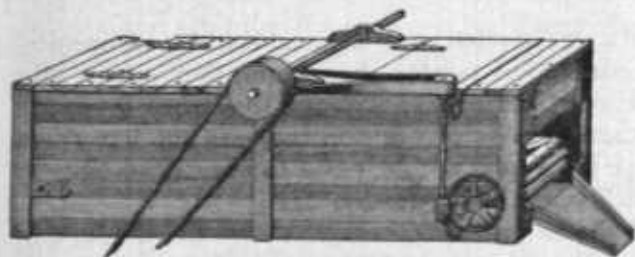


FIG. 10.—A horizontal power bleacher.

this portion of the bleacher coated with cement or lined with asbestos, especially the floor, to lessen the danger of fire.

Perhaps the most satisfactory bleacher for evaporators in which an engine is installed is the "power" or "horizontal" type shown in figure 10. Its characteristic feature is the movable bottom, or rather false bottom, on which the fruit is carried through the bleacher.

Briefly stated, this bleacher consists of a tight box about 3 feet square and 20 or more feet long, the length being regulated by the capacity of the evaporator in connection with which it is operated and the time it is desired to bleach the fruit.

The apples are conveyed from the paring room to the bleacher by a carrier, or elevator, similar to those already referred to, and are dropped into one end of the bleacher, falling on the movable bottom, which consists of an endless belt of "lugs," turned by the proper gear attachment. The speed of movement is governed by the gearing, and is adjusted to correspond with the time it is desired to keep the fruit in the bleacher and the length of the latter. When the fruit has been carried through the bleacher, it passes to the slicer, which is located in close proximity to the bleacher. The end of the bleacher shown in the illustration is closed when in actual operation



by means of a closely fitted piece of canvas or other effective arrangement. Provision for the escape of the fumes may be supplied as suggested in connection with the upright type previously described.

#### **SULPHUR STOVES.**

In a large proportion of instances nothing more elaborate than a broken or otherwise discarded iron kettle or some similar receptacle is used for containing the burning sulphur. This is the case if the compartment in which the sulphur is burned is a portion of, or in direct communication with the bleacher. In other instances, such as the power bleacher just described, where in some cases it is more convenient to burn sulphur at some distance from the bleacher, a small sheet-iron stove about a foot square and 12 or 15 inches high is used. This is connected with the bleacher by means of a small stovepipe.

#### **SLICING MACHINES.**

There are several styles of slicers now obtainable which are operated by hand, foot, or mechanical power. In general, they consist of a table in which a series of knives is so arranged that when the apples are carried over them by a revolving arm they are cut into slices. In at least one type the apples are delivered to the slicing table by an attachment which works automatically.

The capacity of slicers varies somewhat, as does the industry of the men who operate them, but from 200 to 400 bushels for a day of ten hours may be expected of a good machine.

Small hand slicers which slice only a single apple at a time are sometimes used in the smaller evaporators.

Quartering machines are used instead of slicers, if it is desired to dry the fruit in quarters instead of slices.

#### **CRATES AND TRAYS.**

Crates and trays are essential accessories. A relatively large supply facilitates the handling of the fruit both before and after it is pared, especially where there are no elevators or carriers to convey the fruit from one point in the evaporator to another. They are usually made to hold about a bushel. The bottoms of those in which apples are bleached should be made of narrow slats, and preferably also the sides, to permit a free circulation of the sulphur fumes through the fruit.

#### **RACKS.**

In the construction of all racks on which fruit is dried, whether for use in a large tower evaporator or in a small cook-stove type, a special caution should be observed to select only the best grades of

galvanized-wire netting for making the racks. If poorer grades are used the acids of the fruit are likely to act on the metals, producing undesirable results.

### HEATING APPARATUS.

Satisfactory results are so dependent upon the heating apparatus that this becomes one of the most important features of an evaporator.

In the smaller types of evaporators, where comparatively little is involved and the question of fuel does not enter seriously into consideration, almost any small stove commensurate with the size of the particular evaporator in question may be used.

In the larger kiln evaporators the matter is a more important one. Formerly, ordinary cast-iron stoves were used considerably, two or more of them frequently being required to heat a single kiln, but these have largely gone out of use. In their stead large furnaces are now most commonly used. These are specially designed for the purpose and are provided with relatively large fire pots, correspondingly large ash pits, and large radiating surfaces. As it is necessary to burn a relatively large quantity of fuel in a given time, the size of the grate is made with this end in view. For a kiln floor 20 feet square, or 400 square feet of surface, the grate surface is usually about 3 feet in diameter, containing from 5 to 7 square feet.

As to the most satisfactory length of pipe connecting the furnace and chimney, opinions differ. Perhaps the most common method of piping is the one indicated by figure 3, *H, H*, page 9. The furnace, with two flanges for attaching the pipe, is placed in the center; the pipe from each flange is then extended to the side of the room opposite the chimney, and from this point the two sections, extending in opposite directions, follow the wall, at a distance of 2 or 3 feet from it, to the chimney. In a kiln 20 feet square, some 65 or 70 feet are thus required. Ten-inch pipe is a common size to use for this purpose. It is placed about 3 feet below the kiln floor.

Some operators think that a better distribution of heat is obtained if the pipes extend back and forth, 2 or 3 feet apart, under the entire floor of the kiln, thus requiring 200 feet or more instead of the shorter length above suggested. The greater length, however, is less frequently used than the smaller.

In some cases the heat is so intense directly over the furnace that the fruit dries more rapidly in the center of the floor than about the sides. To regulate this and make the drying as uniform as possible, a "deflector," consisting of a piece of sheet iron or tin several feet square, is attached to the floor directly above the furnace.

Open grates, which in effect are furnaces with all parts above the grates removed, are used occasionally and are recommended by some



because they require less fuel, less attention to firing, and will dry the fruit in a shorter space of time. On the other hand, so much dust rises from them that they are not used in making the best grades of fruit.

Tower evaporators may be heated by the same style of furnaces that are used in kiln driers. The size of furnace sufficient to evaporate a given quantity of fruit in a given time is probably about the same in either type of evaporator.

In some respects a steam system is the most satisfactory method of heating, but it is comparatively little used, possibly due to the larger first cost of installing such a system. It is especially applicable in case of evaporators that are operated in connection with some other business that requires the use of considerable steam power, such as a large cider mill which requires the power for running the presses.

In kiln evaporators the steam pipes are generally placed in as close proximity to the floor of the drying room as is convenient—within a foot or even closer. That every steam pipe nearest the floor may supply the greatest amount of heat it should have its own return to the main return of the system.

One-inch pipe is generally used for such systems. No very definite data are available in regard to the amount necessary to supply the requisite heat. Several kilns, however, which are said to work admirably, have about 650 running feet of pipe for every 100 square feet of floor space. One-half of this is "riser," the other half "return."

In the type of evaporator described on page 17, the length of 1-inch steam pipe required per square foot of surface directly exposed to the pipes is considerably less than in the case of the kiln just described, although it is probable that in the system in question a greater degree of heat can be maintained than with the usual piping for a kiln. As previously mentioned, in this system the pipes are arranged in horizontal tiers, the racks on which the fruit is placed being inserted between them. Hence, the upper racks receive more or less heat from the lower tiers, as well as from those to which they are directly exposed. In one evaporator of this type, which gives excellent satisfaction, and in which the drying compartments are about 9 feet square—that is, large enough to hold four 4-foot racks (two square) in the same plane—there are thirty-two 1-inch pipes in each tier. Each pipe is about  $8\frac{1}{2}$  feet in length, or approximately 270 feet in each tier. In the evaporator referred to there are 8 tiers in each compartment. Eight racks—two deep—are placed between each tier of pipes.

In another evaporator of this type, having a capacity of 400 bushels every twenty-four hours, a 40-horsepower boiler, with about

15 square feet of grate surface, furnishes the necessary steam when run at a pressure of 40 to 50 pounds. This is sufficient for drying the fruit and for running the parers, slicers, elevators, etc., required to handle this quantity of fruit. The steam pressure at which such systems are run varies considerably according to the individual requirements of the systems. A range of from 40 to 90 pounds has been noted in different evaporators.

### FUEL.

Where the owner of an evaporator has an abundant supply of wood and it can be cut at times of leisure, this is probably the least expensive fuel in actual cash outlay that can be had in most of the apple-growing sections. In fact, under these conditions, it is commonly estimated that the fuel costs nothing. But in a great number of cases fuel has to be bought, even by operators who are drying apples from their own orchards.

For kiln evaporators using the common type of furnaces, hard coal is probably the most satisfactory fuel, and requires less attention than any other. Coke is sometimes used, and if it were as satisfactory as coal, other things being equal, it would be the cheaper fuel. But it requires much attention, and even with the best of care it is difficult to maintain a uniform degree of heat. A combination of coal and coke is sometimes used with satisfactory results, in which case the faults and advantages of one tend, in a measure, to equalize those of the other.

In a steam-heated plant soft coal serves the purpose in a satisfactory way, and in most apple-growing sections is probably cheaper than any other fuel that is readily available.

**Quantity of fuel required.**—While the amount of fuel necessary to dry a given quantity of fruit will vary more or less, depending upon the conditions of the weather, the efficiency of the furnace, the construction of the kiln, the percentage of moisture to be left in the fruit, and various other things, it is roughly estimated that a ton of hard coal, for a kiln evaporator, will make a ton of dried fruit. Probably the average requirement is rather more than this. It is claimed that a tower evaporator requires slightly less for the same results. Open grates also considerably reduce the amount of fuel necessary for a given quantity of fruit, but on account of their objectional features they can not be used for the better grades of apples. Coke is rather more efficient, 2,600 to 2,700 pounds of apples being evaporated, it is claimed, by a ton of fuel.

A good steam system should require considerably less than a ton of soft coal to a ton of dried fruit, one estimate being about one-half this amount.

These estimates are for evaporating sliced fruit. If the apples are quartered or dried whole, being merely pared and cored, considerably more fuel is required. From 25 to 50 per cent more fuel should probably be estimated for in such cases.

### APPLES SUITABLE FOR EVAPORATION.

There is an increasing demand for dried apples of the highest quality. The tendency has sometimes been to make quantity at the expense of quality. But prices are governed not only by the supply but also by the grade. The cleanest, whitest fruit, that is well cored, trimmed, bleached, ringed, and dried, is most in demand. Carelessness in any particular injures the product.

Primarily the economic usefulness of an apple evaporator is through its utilization of windfalls and the poorer grades of fruit which can not be marketed to good advantage in a fresh state, and it is these grades that are most often evaporated. But the magnitude of the crop also influences the grade of the evaporated product in a decided way. In seasons of abundant crops and low prices for fresh fruit large quantities of apples that would ordinarily be barreled are evaporated and the grade of stock produced is correspondingly improved. On the other hand, in years of scanty crops, when all apples that can possibly be shipped are in demand at high prices, only the very poorest fruit is evaporated, as a rule, thus lowering the grade of the output.

The commercial grading of evaporated apples is based primarily on appearance rather than on dessert quality, and the fact that one variety may make a better flavored product than another is not considered. As a rule, a product of high commercial grade can be made from any sort which has a firm texture and bleaches to a satisfactory degree of whiteness. A variety of high dessert quality, such as the Northern Spy, may be expected to make an evaporated product of correspondingly high flavor.

In sections where the Baldwin apple is grown extensively it is in demand at the commercial evaporators, as it meets the requirements in a fair degree and it is also available in relatively large quantities. In the Ben Davis sections that variety supplies a similar demand.

Most early varieties lack sufficient firmness of texture for the best results and are undesirable on this account. On the other hand, some comparatively early sorts, such as Gravenstein and Yellow Summer Pearmain, are considerably prized in some sections; the dessert quality of the latter is especially high.

Similarly the product made from other sorts possesses qualities that are due more or less to varietal characteristics. For instance, that

from Esopus is said to be unusually white; Hubbardston and varieties of the Russet group also make very white stock. The latter make relatively a large amount of stock, by weight, to a given quantity of fresh fruit. Limbertwig is said to produce from  $1\frac{1}{2}$  to 2 pounds a bushel more of dried stock than most sorts do, but it is not as white as that from some other varieties.

## PREPARING THE FRUIT FOR DRYING.

### PARING.

No special comments are necessary under the head of paring, save to mention this step in the order in which it occurs in the preparation of the apples for drying. The apples are cored in the same operation by an attachment applied to the paring machine for this purpose. The fruit is automatically forced from the fork and drops to the table, where it is next taken in hand by the trimmers. In the smaller evaporators the slicing is often done at the time of paring by a slicing attachment applied to the parers.

In nearly all the evaporators the paring and trimming are done by women and girls.

### TRIMMING.

In paring the fruit there is usually more or less skin left around the stem and calyx of the apples and any irregular places that may occur. There will be wormholes, decayed spots, and other blemishes which will detract from the appearance of the product, if allowed to remain. Even bruises are objected to by the most exacting operators. Hence all such defects are cut out as soon as the fruit is pared if the highest grade of product is expected. This is done with an ordinary straight-back, sharp-pointed knife, having a blade  $2\frac{1}{2}$  or 3 inches long.

### BLEACHING.

The fumes of burning sulphur are employed not only to make the fruit white where the freshly cut surfaces have become discolored by contact with the air, but to prevent further discoloration after it is sliced. Sulphuring is also generally supposed to be necessary to destroy fungi and insects, though under present methods of handling this is open to question.

There are no definite standards governing the bleaching as to the time required, amount of sulphur necessary to accomplish the desired end, etc. The aim is to treat until enough of the fumes have been absorbed by the apples to prevent discoloration after they are sliced and exposed to the air. If it is found that the fruit is not retaining its clean, white appearance with the treatment that is being given, either the length of time that the fruit is kept in the bleacher

is increased or more sulphur is burned in the customary time for bleaching. Due caution should be exercised, however, in this connection, inasmuch as the bleaching of desiccated fruits with sulphur fumes is open to criticism. The sale of fruit containing sulphurous acid in any considerable quantity is prohibited by the pure-food laws of some States, as well as being restricted in some of the foreign markets. The Federal pure-food law will also make definite restrictions. (See p. 33.)

In many cases the bleaching process is doubtless continued much longer than is necessary for the desired results. Until some definite standards are established and recognized, the greatest care should be exercised not to bleach more than the minimum required to maintain the desired color a reasonable length of time.

The allotted time for bleaching in a large number of evaporators, from which information has been secured, varies from twenty minutes to one and one-half hours. The more usual time appears to be about forty-five minutes. This, however, may be regulated in a measure by the amount of sulphur burned in a given time.

The estimates regarding the amount of sulphur used to bleach a ton of fruit vary from 4 or 5 pounds to 20 pounds, though but little information of a definite character is to be obtained at present.

The usual practice is to start the sulphur fumes by putting a few live coals into the receptacle used for the purpose, then adding a small piece or two of stick brimstone. Before this has all been vaporized, more is added. This is continued as long as the bleacher is in operation, sufficient heat being generated to vaporize the sulphur without the further addition of burning coals.

When apples are dried whole, without slicing or quartering, they require less bleaching than if they are to be sliced, inasmuch as the interior of the fruit does not come in contact with the air.

For the most satisfactory results it is essential that the fruit be put into the bleacher in the shortest possible time after the surface is exposed to the air by paring. If a long delay occurs the surface becomes discolored, in which case it does not regain its original whiteness in the bleaching process.

#### **SLICING, QUARTERING, ETC.**

After bleaching, the next step in preparing the fruit is slicing, unless instead of slicing it is quartered or dried whole, as is done to a limited extent. In preparing fruit for some of the smaller evaporators, as previously mentioned, the slicing is done when the fruit is pared; the bleaching then follows the slicing instead of preceding it.

The slices are one-fourth inch in thickness, and in the largest degree possible should be cut at right angles to the hole made through

the axis of the apple when the core is removed by the parer, thus producing the "rings," which is the form most desired. Other things being equal that fruit is sliced the best which contains the largest proportion of "rings," and this point is given more or less weight in grading the finished product.

When it is desired to evaporate apples in quarters or sixths they are run through machines which cut them accordingly, the cutting being done in the opposite direction from the slicing; that is, in a direction parallel to instead of at right angles to the axis of the apple.

If they are to be dried whole, they are transferred from the bleacher directly to the drying compartment without further treatment.

### **DRYING THE FRUIT.**

When the fruit has been placed in the drying compartment of an evaporator, of whatever type it may be, it has reached the most critical stage in the whole process of evaporation, and it is here that the greatest care and skill are required to insure the best possible results.

#### **CAPACITY OF FLOOR SPACE AND RACKS.**

In the case of kiln evaporators, the sliced fruit is evenly spread on the floor to the depth of from 4 to 6 inches. A kiln 20 feet square will hold the slices of from 120 to 150 bushels of fresh fruit, depending upon the amount of waste in the apples and the exact depth to which they are spread on the floor.

If the fruit is in quarters or is dried whole, it may be somewhat thicker on the floor, since in these forms it does not pack down as closely as the slices do and hence does not impede the circulation of hot air through it if the depth is somewhat increased.

In tower evaporators and other types where the fruit is handled on racks the slices are seldom placed much more than 1 inch in depth. A rack 4 feet square will hold from three-fourths of a bushel to a bushel.

The fruit is generally put on the floor of the kiln as fast as it is sliced, and the fire is started in the furnace below as soon as the floor is filled, or, in many cases, before it is entirely covered.

#### **OILING THE FLOORS AND RACKS.**

It is a common practice to treat the floor of kilns occasionally with tallow to prevent the fruit from sticking to it. This is done every few days, or as often as conditions appear to make it advisable. Sometimes a mixture of equal parts of tallow and boiled linseed oil is used for this purpose.

Another practice, with the same end in view, is to thoroughly scrub the floors as often as is necessary with water, using with it some one



of the scouring soaps. This is preferred by some operators, who claim that oil or tallow discolors the fruit.

At each filling of the racks, where these are used, the surface of the wire netting is lightly wiped over with a cloth moistened in lard. This prevents the fruit from sticking to the netting and keeps it clean.

#### **TEMPERATURE MAINTAINED.**

The temperature maintained in kilns or other drying compartments, in actual practice is largely a matter of experience, not a factor governed by any definite standards or regulated in accordance with thermometer readings, as might be expected. In general, the object in view is to force the heat as high as possible without endangering the fruit. A probable temperature which has been suggested by some of the operators is 150° F., or more when the fruit is first put into the drying compartment, dropping to about 125° F. as the drying process nears completion. Sufficient and proper provision for controlling the indraft of cold air below the fruit will aid in maintaining the desired temperature.

#### **TURNING THE FRUIT.**

In order to prevent the fruit from burning and from sticking to the floor by remaining in contact with it too long, and to insure the most uniform drying that is possible, the fruit, in the case of the kiln driers, is turned occasionally. The interval between turnings varies with different operators, with the condition of the fruit, and with the degree of heat which is maintained. Some operators do not turn the fruit until 5 hours have elapsed after the furnace has been started, while a more common practice is to make the first turning within two to three hours after the drying is begun, or even sooner. For the first five or six hours it is generally turned every two hours or so, and more frequently as the fruit becomes drier, until perhaps it may require turning every half hour when nearly dry.

The objects to be obtained by turning must be kept in mind and the fruit handled accordingly. It should be examined from time to time and turned often enough to prevent scorching or sticking and to insure uniform drying.

In the case of the tower evaporators and other types in which the fruit is handled on racks, no turning more than an occasional stirring of the fruit with the hand or with a small wooden paddle is required. Sometimes the relative positions of the racks are changed to make the drying more uniform. This is one reason why the tower-dried fruit is generally of rather better quality than that from kilns. The repeated turning on the kiln floor is likely to make the fruit more or

less "mussy," while in that which remains practically undisturbed on the racks the rings are maintained in better condition. The fruit also dries more quickly, and is often of better color than the kiln-evaporated product, and hence is more attractive in appearance.

The same general principles must be observed in tending the fruit where steam heat is used in place of direct hot air from furnaces.

#### TIME REQUIRED FOR DRYING.

The time necessary for drying fruit depends upon several factors. The more important are: Type of evaporator; depth to which fruit is spread; method of preparing—whether sliced, quartered, or whole; temperature maintained; conditions of the weather, and, to a certain extent, the construction of the evaporator.

The application of these several factors to the point in question readily follows. A good kiln evaporator should dry a floor of slices, other things being equal, in about twelve hours, ten to fourteen hours being the range of variation. Where the fruit is handled on racks the time required is much shorter, but conditions are quite different from the kilns, as the fruit is seldom more than 1 or 2 inches thick on the racks. For slices, five hours is considered a reasonable time, with a range of four to six hours.

It is estimated that quarters will require from eighteen to twenty-four hours in the average kiln, while the time for whole apples will range from thirty-six to forty-eight hours.

If the atmospheric conditions are heavy and damp, the drying is retarded. Under some conditions it is hardly possible to thoroughly dry the fruit. During windy weather also it is more difficult to regulate the heat, especially if the walls are poorly constructed so that the draft of cold air into the furnace room can not be controlled. This applies especially to kilns heated by furnaces. It is claimed that steam-heated evaporators are less subject to the influence of climatic conditions.

#### WHEN IS THE FRUIT DRY?

Perhaps there is no step in the entire process that requires better-trained judgment than the matter of determining when the fruit is sufficiently dried to meet the requirements. Like several other steps in the process it is largely a matter of experience, though there are certain general features which are capable of being reduced to words.

The fruit should be so dry that when a handful of slices is pressed together firmly into a ball the slices will be "springy" enough to separate at once upon being released from the hand. In this condition there will be no fruit, or only an occasional piece, that has any visible moisture on the surface. In a slice of average dryness, it should



not be possible to press any free juice into view in a freshly made cross section of it. The general "feel" of the fruit, as it is handled, should be a soft, velvety, leathery texture.

The foregoing should represent as nearly as possible the average condition, but it can not be expected to be absolutely uniform throughout. Some slices—they should constitute only a very small percentage—will still plainly possess some of the juice of the apple; others—likewise, properly only a small proportion—will be entirely too dry, possibly dry enough to be brittle.

### THE CURING ROOM.

When a quantity of fruit is considered dry enough, it is removed from the kiln and put in a pile on the floor of the curing room. Every day or two the pile should be thoroughly shoveled over to make uniform the changes which take place. Thus managed, the pile in a few days will become thoroughly homogeneous. The pieces that were too dry will have absorbed moisture, the superfluous moisture of other pieces will have disappeared, and the entire mass may be expected to reach the condition above described.

### HANDLING THE WASTE.

In the usual grades of apples that are taken to the evaporator there are many specimens that are too small to pare or which for other reasons can not be profitably used in this way. In the case of some of the larger evaporators which are operated in connection with vinegar factories, these apples, as well as all parings and trimmings, are used for "vinegar stock," but in the smaller ones these portions are usually dried. It is generally estimated that about one-third as much space is required to dry the parings and trimmings as is demanded for the "white fruit."<sup>a</sup>

"Waste" and "chops" are generally bleached, but are seldom passed through the bleacher which is used for the white fruit. Where they are dried in kilns, which is usually the case, a common way of bleaching is to burn the sulphur in the furnace room after the stock has been spread on the floor.

It is generally estimated that the waste from a given quantity of apples will pay the cost of the fuel for evaporating that quantity of fruit; that is, putting it on a bushel basis, the waste from a bushel will pay for fuel to evaporate both the white fruit and the waste from that bushel. While in some instances, when the price of such

---

<sup>a</sup> "White fruit" is a general term used by operators and dealers to denote the grades used for culinary purposes, in distinction from "waste," which comprises the parings and trimmings, and "chops," which are composed of the apples that are too small and otherwise defective to pare.

stock is low, this estimate may be too high, it not infrequently happens that it more than pays for the fuel.

### **WEIGHT OF EVAPORATED APPLES.**

Some varieties of apples will make more evaporated stock to the bushel than others. The grade used also affects the amount, but an average weight—a frequent basis of estimates—is about  $6\frac{1}{2}$  pounds of white fruit and  $3\frac{1}{2}$  pounds of waste to a bushel of fresh fruit. When the apples are dried whole, without slicing, they will make from 1 to 2 pounds more to the bushel than when sliced.

### **LAWS RELATING TO EVAPORATED FRUITS.**

So far as the writer has been able to learn, only one State has enacted laws, aside from those relating to the presence of sulphurous acid or sulphites, regulating the quality or condition of evaporated or dried fruits offered for sale.

In 1904 the New York legislature amended the agricultural law so as to prohibit the sale of adulterated evaporated apples. This act became a law on April 26, 1904, and is recorded in Chapter 391. It is intended primarily to regulate the moisture content of evaporated fruit when offered for sale. For the purpose of the act, evaporated apples are considered "standard" if they do not contain more than 27 per cent of water or fluids as determined by drying for four hours at the temperature of boiling water.

It will thus be seen that evaporated apples, in the terms of this law, are considered "adulterated" if they contain more than 27 per cent of moisture.

The pure food laws of some States also apply in certain instances, especially those which make specifications in regard to the presence of sulphurous acid or sulphites in food products. This reference to the matter should be sufficient to call the attention of manufacturers and dealers to its importance.

A California statute, approved March 20, 1903, requires that all fruit, green or dried, contained in boxes, barrels, or packages, and offered for shipment in the State be so labeled as to designate the county and immediate locality in which the fruit was grown, but a decision of the supreme court of the State declares this law to be unconstitutional.

A decision of the Board of Food and Drug Inspection under the pure-food law enacted by the first session of the Fifty-ninth Congress of the United States relative to the maximum amount of sulphurous acid permissible in evaporated or desiccated fruits is now awaited with interest.

The attention of all interested persons, especially exporters, should further be called to the fact that "the governments of Prussia and

Saxony, in order to unify the practices of inspectors of desiccated fruits, have issued decrees fixing the limit of sulphurous acid in desiccated fruits at 0.125 per cent."<sup>a</sup>

The presence of sulphurous acid in desiccated fruits, and also of zinc in fruit dried on galvanized wire racks, has frequently been criticised in foreign markets and has been the source of unfavorable judgment, resulting in more or less agitation favoring laws restricting or prohibiting the sale of such fruit.

### HANDLING EVAPORATED APPLES.

While comparatively few of the manufacturers of evaporated apples pack their own fruit for the trade, it will be of interest to them and of direct value to know something of the methods pursued by dealers, and especially in regard to grading and the requirements of the various grades.

The product of all grades is generally shipped to the dealers in gunny sacks having a capacity of  $1\frac{1}{2}$  or 2 bushels. The "white fruit" is usually bought by the pound. Sometimes the waste is rated by the hundredweight. The price paid is not governed by the market conditions alone; the quality is an important factor.

### RANGE OF PRICES.

In 1904 the output of evaporated apples was very large and in excess of immediate trade demands. The prices were correspondingly low. Because of a light crop of apples in the season of 1905, the quantity of evaporated apples was relatively small. There was a large quantity of fruit evaporated in 1906, but trade conditions were rather unusual and prices varied accordingly. An idea of the range of prices at the evaporators is suggested by the following rates which prevailed in New York during the three seasons just mentioned:

Year.	White fruit, per pound.	Chops, per hundredweight.	Waste, per hundredweight.
	<i>Cents.</i>		
1904.....	$3\frac{1}{2}$ to $4\frac{1}{2}$	\$0.75 to \$1.15	\$0.60 to \$0.85
1905.....	7 to $7\frac{1}{2}$	2	1 to 1.25
1906.....	4 to $7\frac{1}{2}$	1.75 to 2	.90 to 1.25

The market price of whole apples is usually a cent or more a pound higher than that for sliced fruit; quarters also bring a higher price.

In cases where special pains are taken in trimming and in other processes in preparing the fruit and the finished product is particularly white and clean, better prices than the prevailing market rates can often be obtained.

<sup>a</sup> Decision No. 7 of "Food Inspection Decisions 1-25," Bureau of Chemistry, U. S. Department of Agriculture.

## GRADING.

In classifying evaporated apples, three grades are generally recognized, which are commonly designated as "fancy," "choice," and "prime." Two other grades, which in reality are special grades, are also sometimes recognized, viz, "extra fancy," and a lower grade than prime—usually called prime with some prefix, frequently the name of a locality, to distinguish it from that grade.

The standards demanded for these various grades are about as follows:

"Fancy" is very white, clean stock, free from all pieces of skin and other objectionable portions which should be removed in trimming, and a good proportion of the slices in rings.

"Choice" denotes a grade intermediate between "fancy" and "prime," not quite clean enough for "fancy," yet more nearly free from imperfections than the "prime" grade demands.

"Prime" must be good stock, well cured, and of a generally attractive appearance. It must be comparatively white and mostly free from undesirable portions, but stock having a small percentage of such defects is usually put in this grade.

"Extra fancy," as the name implies, is a fancy grade that is exceptionally fine. It must possess all the qualities mentioned in describing that grade in a marked degree. At least 85 per cent of the slices should be "rings."

The grade below "prime" is the stock that has been so carelessly handled and is so unattractive in appearance that it can not maintain the standard of "prime." It is packed for an entirely different and much poorer class of trade than any of the other grades.

## KINDS OF PACKAGES USED.

In packing the fruit, several sizes of packages are in common use. While the proportionate dimensions of the packages may vary with the different dealers and packers, their capacity is more or less a matter of uniform standards.

Perhaps the package most used is the 50-pound wooden box. A common form of this box is 10½ by 11 by 22 inches, inside measure. Twenty-five-pound boxes are likewise much used; these are commonly made 9 by 9 by 18 inches, inside dimensions. A box holding 55 pounds of sliced fruit, having inside measurements of 11 by 11¼ by 22½ inches, is much used for the export trade. These are generally marked "25 kilos" when intended for export, instead of having the capacity designated in pounds.

Pasteboard cartons, holding 1 pound, or one-half kilo (1.1 pounds) for certain export trade, are also more or less used for the better

grades of sliced fruit. These cartons are generally packed in a box or case, 48 cartons to the case. The cartons are 2 by 5 by 7 inches; the case is about 12 by 16 by 21 inches.

All of these packages are used as desired for slices or "rings," but the quarters and whole fruit are generally packed in the 55-pound boxes, which, however, are expected to contain but 50 pounds of fruit in these forms.

### PACKING.

The side of the box intended for the top or "face" is packed first, as in packing fresh fruit in boxes or barrels. The first step in pack-

ing, therefore, is to "face" this side. The "facers" are slices which are perfect rings. These are usually selected from a quantity of fruit which contains a relatively large proportion of them; they are then placed on thin boards which are slightly smaller than the top of the box, inside measure, overlapping one another in rows, lengthwise of the board. Figure 11 shows such a "board" of facers. The facers are put in place by inserting the board on which they are arranged into the box, which is first lined with paraffin paper, and then with a dexterous movement of the hand flipping the layer of rings against the inner face or the bottom, which is to become the top of the box.

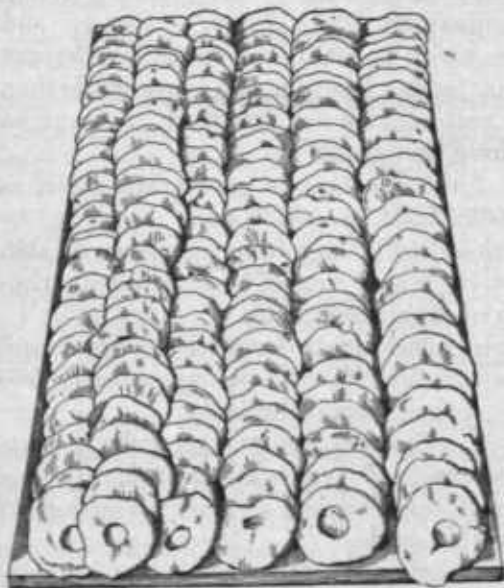


FIG. 11.—A "board" of facers.

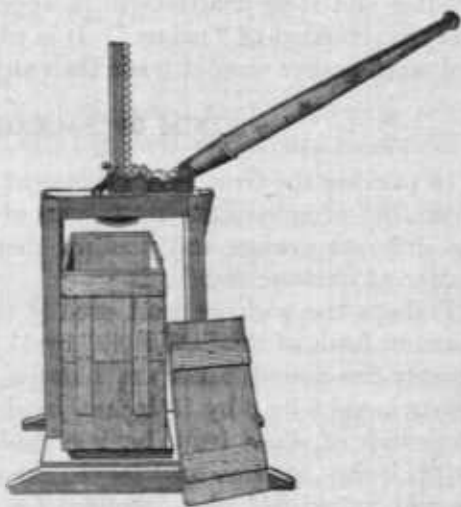


FIG. 12.—A press used in packing evaporated apples.

A press similar to figure 12 is generally used in filling the boxes. Three men compose a packing gang for each press; one to fill the boxes and weigh the fruit; one to operate the press; a third to nail on the cover, which now becomes the bottom of the box.

In filling the boxes, an extension of the box upward is necessary, since 50 pounds of evaporated apples have to be compressed greatly in order to get them into a box of the required dimensions. This extension may be another box of same size with a rim nailed around the edge to fit over the box to be filled. The box is placed on a pair of scales and filled with the desired quantity of fruit, by weight; it is then passed to the press. A "follower" slightly smaller

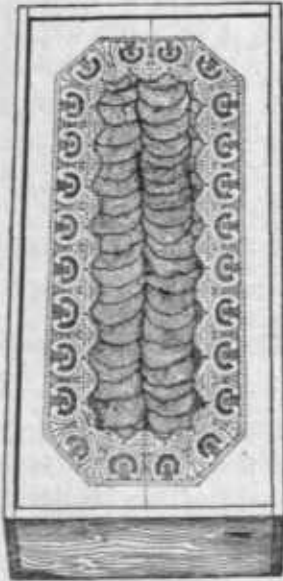


FIG. 13.—A 50-pound box of "fancy" evaporated apples with cover removed.

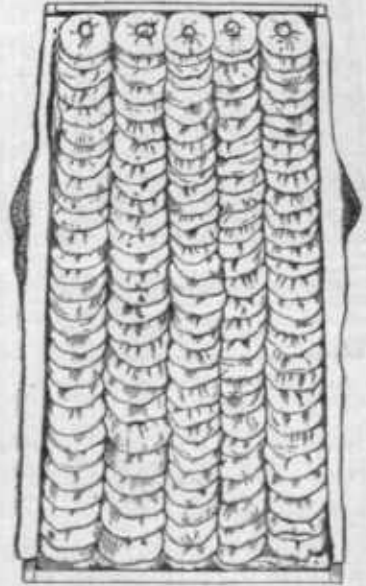


FIG. 14.—A 50-pound box of "fancy" evaporated apples with cover and paper lace removed.

than the box is put in position over the fruit and this is pressed down until the fruit reaches the desired point.

Quarters and whole apples are handled in essentially the same manner except in regard to the facing. In facing whole apples they are placed on the side in rows lengthwise of the bottom (when packed, the top) of the box. The boxes are then filled the same as with slices. Quarters are handled in the same way.

Figure 13 is a box of fancy evaporated apples with cover removed, showing the paper lace used for decorative effect. Figure 14 is the same box with the paper covering entirely removed. Figures 15 and 16 show, respectively, a box of whole apples and one of quarters.



Cartons are filled by hand, the work usually being done on a table of convenient height. Each package is weighed to insure its proper content of fruit.

The sun-dried fruit, of which quite large quantities are handled



FIG. 15.—A 50-pound box of "prime" whole apples.



FIG. 16.—A 50-pound box of "prime" quarters.

by some dealers, is usually packed in sugar barrels. This is largely exported. The waste is also generally put into barrels, 240 to 250 pounds net usually filling a barrel. Chops are handled in a similar manner.

### STORING THE FRUIT.

In years of great abundance of apples, the evaporated product is likely to exceed the immediate demand. While fruit that has been well bleached and cured can be held for a considerable period of time without loss it is by no means imperishable. The color is first to deteriorate. The fruit appears to lose the effect of bleaching after a time and turns dark. Though it may retain its flavor for a long time, its unattractive appearance renders it more or less unsalable.

When it is desired to hold evaporated apples from one season to another, recourse is had to cold storage. Some seasons large quantities are handled in this way. The temperature at which it is stored is usually from 32° to 35° F., or about the same as for fresh fruit. If well bleached and properly cured it may be held for a relatively long period. Four or five years is said by commercial handlers to be about the usual limit of time before the color deteriorates. It is seldom, however, that it is desirable to hold the fruit for so long a time.